ORDINANCE NO. 3240

BILL NO. 78 (2004)

A BILL FOR AN ORDINANCE AMENDING TITLE 16, MAUI COUNTY CODE, PERTAINING TO ENERGY EFFICIENCY STANDARDS FOR BUILDINGS

BE IT ORDAINED BY THE PEOPLE OF THE COUNTY OF MAUI:

SECTION 1. Section 16.26.1300, Maui County Code, is repealed.

["Chapter 13

ENERGY CONSERVATION

Sec. 1301 (a) Scope. The provisions of this section regulate the design and construction of the exterior envelopes and selection of heating, ventilating and air-conditioning, service water heating, electrical distribution and illuminating systems and equipment required for the purpose of effective conservation of energy within a building or structure governed by this code. Compliance with applicable provisions of ASHRAE Standards No. 90A-80 shall be deemed to meet the requirements of this chapter.

(b) Applicability. The energy efficiency building standards shall be enforced at the time of construction of a new building and shall also be applied, in part, to that portion of a major addition, alteration or repair of an existing building when the proposed major addition, alteration or repair must comply with the standards applicable to new buildings under this code.

EXCEPTIONS:

1. Buildings and structures, or portions thereof, which are not heated or cooled shall be exempt from the provisions of Sections 1303 through 1306 regulating exterior envelope and heating, ventilating and air-conditioning systems.

2. Buildings and structures whose peak design rate of energy usage is less than one watt per square foot or 3.4 Btuh per square foot of floor area for all purposes shall be exempt from all provisions of this chapter.

3. Dwelling unit which is not heated or cooled, or where cooled with air-conditioning systems totaling less than 12,000 Btuh capacity, shall be exempt from all provisions of this

chapter except Sections 1308 and 1309 pertaining to the conservation of hot water.

4. For special applications such as hospitals, laboratories, thermally sensitive equipment, computer rooms, and manufacturing and industrial processes, the design concepts and parameters shall conform to the requirements of the application at minimum energy levels.

(c) Plans and Specifications. Plans, specifications and necessary computations shall be submitted to indicate conformance with this chapter. Plans and specifications for work to comply with the provisions of this chapter shall be prepared, designed or approved by a duly registered professional engineer or architect as required by chapter 464 of the Hawaii Revised Statutes.

(d) Information of Plans and Specifications. The plans and specifications shall show in sufficient detail all pertinent data and features of the building and the equipment and systems as herein governed including but not limited to: exterior envelope component materials, U values of the respective elements including insulation, R values of insulating materials, size and type of apparatus and equipment, equipment and system controls and other pertinent data to indicate compliance with the requirements of this chapter.

(e) Alternative Systems. Alternative building systems and equipment design shall be approved by the building official when it can be demonstrated that the proposed energy consumption will not exceed that of a similar building with similar energy requirements designed in accordance with the provisions of this chapter.

When such alternative systems utilize solar, geothermal, wind or other nondepletable energy sources or utilize waste heat for all or part of its energy sources, the nondepletable energy or recovered waste heat supplied to the buildings may be excluded from the total energy chargeable to the proposed alternative design.

Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis prepared in accordance with established principles of environmental technologies (such as ASHRAE Standard 90).

Sec. 1302. Definitions. The following terms are defined for specialized use within this chapter.

ASHRAE. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

COEFFICIENT OF PERFORMANCE (COP) - Cooling.

1. Electrically operated HVAC equipment. The ratio of the rate of net heat removal to the rate of total energy input expressed in consistent units and under designated rating conditions. That rate of net heat removal as used within this definition shall be the change in the enthalpies of the air entering and leaving the equipment (without reheat). The total energy inputs as used within this definition shall be determined by combining the energy inputs to all elements of the equipment, including, but not limited to, compressors, pumps, supply-air fans, return-air fans, condenser-air fans, cooling tower fans and pumps, and the heating, ventilating and air-conditioning system equipment control circuit.

2. Applied HVAC system components. The ratio of the rate of net heat removal to the rate of total energy input expressed in consistent units and under designated rating conditions. The rate of net heat removal as used within this definition shall be the difference in enthalpies of the water or refrigerant entering and leaving the component. The total energy input as used within this system shall be determined by combining the energy inputs to all elements and accessories of the component, including, but not limited to, compressors, internal circulating pumps condenser-air fans, evaporative-condenser cooling water pumps, purge, and the heating, ventilating and air-conditioning system components control circuit.

3. Heat-operated HVAC system equipment. The ratio of the net cooling output to the total heat input. The rate of net heat removal as used within this definition shall be the difference in enthalpies of the water or refrigerant entering and leaving the component. The total energy input as used within this system shall be determined by combining the energy inputs to all elements and accessories of the component, including, but not limited to, compressors, internal circulating pumps, condenser-air fans, evaporative-condenser cooling water pumps, purge and the heating, ventilating and air-conditioning system components control circuit.

COEFFICIENT OF PERFORMANCE (COP) - Heat Pump, Heating. The ratio of the rate of net heat output to the rate of total energy input expressed in consistent units and under designated rating conditions. The rate of net heat output as used within this definition shall be the change in the total heat contents of the air entering and

leaving the equipment, excluding supplementary heat. The total energy input as used within this definition shall be the combined energy inputs to all elements except supplementary heaters of the heat pump, including, but not limited to, compressors, pumps, supply-air fans, return-air fans, outdoor-air fans, cooling-tower fans and the HVAC system equipment control circuit.

ENERGY EFFICIENCY RATIO (EER). The ratio of net cooling capacity in Btuh total rate of electric input in watts under designated operating conditions.

EXTERIOR ENVELOPE. The elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior, or from unconditioned spaces.

EXTERIOR WALLS. For purposes of this chapter, the gross area of exterior walls consists of all opaque wall areas and partition areas, including foundation walls above grade, peripheral edges of floors, window areas including sash, and door areas, where those surfaces are exposed to outdoor air or unconditioned interior space and enclosed, heated or mechanically cooled space.

FENESTRATION. Any light transmitting opening in a building wall or roof. Included are: (1) the glazing material which may be glass or plastic; (2) the framing, mullions, muntins and dividers; (3) external shading, devices; (4) internal shading devices; and (5) integral (between-glass) shading systems.

FLOOR AREA, GROSS. Gross floor area shall be the floor area within the perimeter of the outside walls of the building under consideration, without deduction for hallways, stairs, closets, thickness of walls, columns or other features.

HEATED SPACE. A space within a building which is provided with a positive heat supply to maintain air temperature of 50°F. or higher.

HVAC. Heating, ventilating and air-conditioning.

OPAQUE AREAS. All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.

PACKAGED TERMINAL AIR CONDITIONER. A factory-selected combination of heating and cooling components, assemblies or sections, intended to serve a room or zone.

POWER FACTOR. The ratio of the true power (watts) to the apparent power (volts x ampere); the cosine of the angle of lag between the alternating current and the voltage waves.

RATE OF NET HEAT OUTPUT. The change in the total heat contents of the air entering and leaving the equipment, not including supplementary heat.

READILY ACCESSIBLE. Capable of being reached safely and quickly for operation, repair or inspection without requiring those of whom ready access is requisite to climb over or remove obstacles or to resort to the use of portable access equipment.

REHEAT. The application of sensible heat to supply air that has been previously cooled below the temperature of the conditioned space by either mechanical refrigeration or the introduction of outdoor air to provide cooling.

ROOF ASSEMBLY. For the purpose of this chapter, a roof assembly shall be considered as all components of the roof/ceiling envelope through which heat flows, thereby creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated or mechanically cooled space.

The gross area of a roof assembly consists of the total interior surface of such assembly, including skylights, exposed to the heated and/or mechanically cooled space.

Where ceiling air plenums are employed, the roof/ceiling assembly shall:

1. For thermal transmittance purposes, not include the ceiling proper nor the plenum space as part of the assembly.

2. For gross area purposes, be based upon the interior face of the upper plenum surface.

SHADING COEFFICIENT (SC).

$$SC = \frac{\text{Solar Heat Gain of Fenestration}}{\text{Solar heat gain unshaded DSB}}$$

Where: DS means double strength
B means grade class

SUPPLEMENTARY HEAT. Heat generated in a heat pump, electrical resistance heat or other heat input not provided through the heat pump cycle.

TERMINAL ELEMENT. The means by which the transformed energy from a system is finally delivered, including, but not limited to, registers, diffusers, lighting fixtures and faucets.

THERMOSTAT. An instrument which measures changes in temperature and control device(s) for maintaining a desired temperature.

UNCONDITIONED. Not heated or cooled.

ZONE. A space or group of spaces within a building with heating or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

Sec. 1303. Exterior Envelope Requirements.

(a) General. The intent of this section is to provide minimum requirements for exterior envelope construction.

In addition to the criteria set forth in this chapter, the proposed design may take into consideration the thermal mass of the building in considering energy conservation in accordance with engineering design standards such as those of ASHRAE.

A building that is designed to be both heated and cooled shall meet the more stringent of the heating and cooling requirements of the exterior envelope as provided in this section when the requirements differ.

(b) Thermal Performance. All buildings and structures, or portions thereof, that are heated or mechanically cooled shall be constructed so as to provide the required thermal performance of the various components.

The required thermal transmittance value (U_o) of any one component such as roof/ceiling, wall or floor may be increased and the U_o value for any other components decreased, provided that the overall heat gain or loss for the entire building envelope does not exceed the total resulting from conformance to the required U_o values.

(c) Residential Buildings Not More Than Three Stories in Height. The following provision shall apply to all buildings and structures, or portions thereof, not more than 3 stories in height and housing Group R Occupancies.

EXCEPTIONS: In locations with less than 500° F heating days, there shall not be a maximum U_o requirement if only heating is provided and the U_o shall not exceed those specified in Table No. 13-A if the building is mechanically cooled.

1. Walls. The gross area of exterior walls above grade, including foundation walls, shall have a combined thermal transmittance value (U_o) not exceeding those specified in Table No. 13-A. The combined thermal transmittance value (U_o) is to be computed using equation 13-1.

$$U_o = \frac{U_{wall}\,A_{wall} + U_{window}\,A_{window} + U_{door}\,A_{door}}{A_o} \quad \ldots \quad (13\text{-}1)$$

NOTE: Where more than one type of wall, window and/or door is used, the U x A term for that exposure shall be expanded into its sub-elements, as: $U_{wall_1}\,A_{wall_1} + U_{wall_2}\,A_{wall_2}$, etc.

Where U_o = the average thermal transmittance of the gross wall area, Btu/h·ft²·F.

A_o = The gross area of exterior walls, ft²

$^{U}wall$ = the thermal transmittance of all elements of the opaque wall area, Btu/h·ft²·F.

$^{A}wall$ = opaque wall area, ft²

$^{U}window$ = the thermal transmittance of the window area, Btu/h·ft²·F.

$^{A}window$ = window area (including sash), ft²

$^{U}door$ = the thermal transmittance of the door area, Btu/h·ft²·F.

$^{A}door$ = door area, ft²

2. Roof/Ceiling. Any building that is heated or mechanically cooled shall have a combined thermal transmittance value (U_o) for roof/ceilings not exceeding those specified in Table No. 13-A. The combined thermal transmittance value (U_o) is to be computed using equation 13-2.

$$U_o = \frac{^{U}roof\ ^{A}roof + ^{U}skylight\ ^{A}skylight}{A_o} \quad \ldots (13\text{-}2)$$

NOTE: Where more than one type of roof/ceiling and/or skylight is used, the U x A term for that exposure shall be expanded into its sub-elements, as:

$^{U}roof_1\ ^{A}roof_1 + ^{U}roof_2\ ^{A}roof_2$, etc.

Where U_o = the average thermal transmittance of the gross roof/ceiling area, Btu/h·ft²·F.

A_o = the gross area of a roof/ceiling assembly, ft².

$^{U}roof$ = the thermal transmittance of all elements of the opaque roof/ceiling area Btu/h·ft²·F.

$^{A}roof$ = opaque roof/ceiling area, ft²

$^{U}skylight$ = the thermal transmittance of all skylight elements in the roof/ceiling assembly, Btu/h·ft²·F.

$^{A}skylight$ = skylight area (including frame), ft².

3. Floors over Unheated Spaces. The floor of a heated or mechanically cooled space located over an unheated space shall have a combined thermal transmittance value (U_o) as specified in Table No. 13-A.

(d) Other Buildings. The following provisions shall apply to all buildings and structures, or portions

thereof, except those covered within subsection (c) above.

1. Heating Criteria for Walls. All buildings and structures, or portions thereof, that are heated shall have a combined thermal transmittance value (U_o) for the gross area of exterior walls not exceeding those specified in Table No. 13-B. The combined thermal transmittance value (U_o) is to be computed using equation 13-1.

2. Heating Criteria for Roof/Ceiling. All buildings and structures, or portions thereof, that are heated shall have a combined thermal transmittance value (U_o) for roof/ceiling assemblies not exceeding those specified in Table No. 13-B. The combined thermal transmittance value (U_o) is to be computed using equation 13-2.

3. Heating Criteria for Floors over Unheated Spaces. The floor of a heated space located over an unheated space shall have a thermal transmittance value (U_o) not exceeding those specified in Table No. 13-B.

4. Cooling Criteria for Walls. All buildings and structures, or portions thereof, that are mechanically cooled shall have an overall thermal transfer value for the gross area of exterior walls not exceeding those specified in Table No. 13-B. The overall thermal transfer value, OTTV, for the gross area of exterior walls is to be computed using equation 13-3.

$$OTTV = \frac{({}^{U}wall \times {}^{A}wall \times TD_{EQ}) + ({}^{A}f \times SF \times SC)}{A_o} + \frac{({}^{U}f \times {}^{A}f \times \Delta T)}{A_o} \quad \ldots (13\text{-}3)$$

NOTE: Where more than one type of wall and/or fenestration is used, the terms shall be expanded into sub-elements, as:

$({}^{U}wall \times {}^{A}wall \times TD_{EQ}) + ({}^{U}wall_2 \times {}^{A}wall_2 \times TD_{EQ2})$, etc.

Where OTTV = overall thermal transfer value.

${}^{U}wall$ = the thermal transmittance of all elements of the opaque wall area, Btu/h·ft²·F.

${}^{A}wall$ = opaque wall area, ft².

${}^{U}f$ = the thermal transmittance of the fenestration area, Btu/h·ft²·F.

${}^{A}f$ = entire exterior wall fenestration area, ft².

TD_{EQ} = value given in Table No. 13-H.

SC = shading coefficient of the fenestration (see Definitions).

A_o = gross area of exterior walls, ft².

ΔT = temperature difference between exterior and interior design conditions, F.

SF = solar factor value given in Btu/h.ft^2, using value from the following table for the peak load time of the cooling system:

SF (interpolate for other directions and times)[1]

Time	N	NE	E	SE	S	SW	W	NW	Horiz.
8 am	21	34	227	186	36	20	20	20	116
10 am	32	61	161	168	76	33	32	32	238
12 n	36	37	39	69	93	69	39	37	282
2 pm	32	32	32	33	76	168	161	61	238
4 pm	21	20	20	20	36	186	227	134	116

5. Cooling Criteria for Roof/Ceilings. All buildings and structures, or portions thereof, that are mechanically cooled shall have a combined thermal transmittance value (U_o) for roof/ceiling assemblies not exceeding those specified in Table No. 13-B. The combined thermal transmittance value (U_o) is to be computed using Equation 13-2.

Sec. 1304. Warm Air Heating, Ventilating and Air-conditioning Systems (All Occupancies Except Group R, Division 3 Occupancies).

(a) Scope. This section applies to air duct systems employing mechanical means for the movement of air used for warm air heating, cooling, ventilation, air-conditioning systems, exhaust systems and combination heating and air-conditioning systems, except that this section shall not apply to systems for the removal of flammable vapors or residues or to systems for conveying dust, stock or refuse by means of air currents.

1. Design Parameters. For calculations under this section, the following design parameters shall apply:

A. Outdoor design conditions shall be based on requirements in Chapter 39, air conditioning and ventilating of the administrative rules of the Department of Health, State of Hawaii.

B. Indoor design temperature shall be 70° F for heating and 77° F for cooling.

C. Indoor design relative humidity for heating shall not exceed 30 percent. For

[1]Where construction has exterior shading such that no sun heat can reach the glass at all hours, its solar factor shall be taken as 21.

cooling, the design relative humidity shall be 50 percent.

2. Mechanical Ventilation. Each mechanical ventilation system shall be equipped with an accessible means for either shutoff or volume reduction and shutoff when ventilation is not required.

3. Simultaneous Heating and Cooling. Systems that employ both heating and cooling simultaneously in order to achieve comfort conditions within a space shall be limited to those situations where more efficient methods of heating and air conditioning cannot be effectively utilized to meet system objectives. Simultaneous heating and cooling by reheating or recooling supply air or by concurrent operation of independent heating and cooling systems serving a common zone shall be restricted as specified herein.

A. New energy may be used for control of temperature minimized as specified in subsections C through H. New energy is defined as energy, other than recovered, utilized for the purpose of heating or cooling.

B. Recovered energy, provided the new energy expended in the recovery process is less than the amount recovered, may be used for control of temperature and humidity.

C. New energy may be used, when necessary, to prevent relative humidity from rising above 60 percent for comfort control or to prevent condensation on terminal units or outlets.

D. Systems employing reheat and serving multiple zones, other than those employing variable air volume for temperature control, shall be provided with a control that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring that coolest air. Single zone reheat systems shall be controlled to sequence cooling reheating.

E. Dual duct and multizone systems shall be provided with a control that will automatically reset the cold air supply to the highest temperature that will satisfy the zone requiring the coolest air and the hot air supply to the lowest temperature that will satisfy the zone requiring the warmest air.

F. Systems in which heated air is recooled, directly or indirectly, to maintain

space temperature, shall be provided with a control that will automatically reset the temperature to which the supply of air is heated to the lowest level that will satisfy the zone requiring the warmest air.

G. For systems with multiple zones, one or more zones may be chosen to represent a number of zones with similar heating/cooling characteristics. A multiple zone heating, ventilating and air-conditioning system that employs reheating or recooling for control of not more than 5,000 cfm or 20 percent of the total supply air of the system, whichever is less, shall be exempt from the supply air temperature reset requirements of subsections D and F of this section.

H. Concurrent operation of independent heating and cooling systems serving common spaces and requiring the use of new energy for heating or cooling shall be minimized by one or both of the following:

(i) By providing sequential temperature control of both heating and cooling capacity in each zone.

(ii) By limiting the heating energy input, through automatic reset control of the heating medium temperature (or energy input rate), to only that necessary to offset heat loss due to transmission and infiltration and, where applicable, to heat the ventilation air supply to the space.

(b) Equipment Performance Requirements. The requirements of this section apply to equipment and component performance for heating, ventilating and air-conditioning systems. Where equipment efficiency levels are specified, data furnished by the equipment supplier or certified under a nationally recognized certification program or rating procedure shall be used to satisfy these requirements.

1. System Equipment. Heating, ventilating and air-conditioning system equipment whose energy input in the cooling mode is entirely electric shall show a coefficient of performance (COP) and energy efficiency ratio (EER) not less than the values specified in Table No. 13-C. These requirements apply to, but are not limited to, unitary cooling equipment (air and water source), packaged air conditioners, and room air conditioners. This paragraph does not apply to

equipment used in areas having open refrigerated food display cases.

Heat-operated cooling equipment shall show a coefficient of performance (COP) in the cooling mode not less than the values specified in Table No. 13-D. These requirements apply to, but are not limited to, absorption, engine-driven and turbine-driven equipment. The coefficient of performance (COP) is determined excluding the electrical auxiliary inputs.

2. System Components. Heating, ventilating and air-conditioning system components whose energy input in the cooling mode is entirely electric shall show a coefficient of performance (COP) and energy efficiency ratio (EER) not less than the values specified in Table No. 13-E.

3. Heat Pumps. Heat pumps whose energy input is entirely electric shall show a coefficient of performance (COP), heating, not less than the values specified in Table No. 13-F.

4. Supplementary Heater. The heat pump shall be installed with a control to prevent supplementary heater operation when the heating load can be met by the heat pump alone.

Supplementary heater operation is permitted during transient periods, such as start-ups, following room thermostat set-point advance and during defrost.

A two-stage room thermostat which controls the supplementary heat in its second stage shall be accepted as meeting this requirement. The cut-on temperature for the compression heating shall be higher than the cut-on temperature for the supplementary heat, and the cut-off temperature for the compression heating shall be higher than the cut-off temperature for the supplementary heat. Supplementary heat may be derived from any source of electric resistance heating or combustion heating.

5. Combustion Heating Equipment. All gas and oil-fired comfort heating equipment shall show a minimum combustion efficiency of 75 percent at maximum rated output. Combustion efficiency shall be determined in accordance with acceptable engineering principles.

(c) Insulation of Ducts. All duct systems, or portions thereof, exposed to nonconditioned spaces shall be insulated in accordance with Section 707.

Sec. 1305. Warm Air Heating, Ventilating and Air-Conditioning Systems in One- and Two-Family Dwellings (Group R, Division 3 Occupancies). All duct systems, or portions thereof, exposed to nonconditioned spaces shall be insulated in accordance with Section 707.

Sec. 1306. Systems Controls in All Occupancies. All heating, ventilating and air-conditioning systems shall be provided controls for all occupancies as specified herein.

(a) Temperature. Each heating, ventilating and air-conditioning system shall be provided with at least one thermostat for the regulation of temperature. Each thermostat shall be capable of being set from 55°F to 75°F where used to control heating only, and from 70°F where used to control cooling only. Where used to control both heating and cooling, it shall be capable of being set from 55°F to 85°F and shall be capable of operating the system heating and cooling in sequence. It shall be adjustable to provide a temperature range of up to 10°F between full heating and full cooling, except as allowed, in Section 1304(a)(3)(H).

(b) Humidity. If a heating, ventilating and air-conditioning system is equipped with a means for adding moisture to maintain specific selected relative humidities in spaces or zones, a humidistat shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above 30 percent relative humidity. Where a humidistat is used in a heating, ventilating and air-conditioning system for controlling moisture removal to maintain specific selected relative humidities in spaces or zones, it shall be capable of being set to prevent new energy from being used to produce a space relative humidity below 60 percent.

(c) Temperature Zoning. In all Group R, Division 3 Occupancies, at least one thermostat for regulation of space temperature shall be provided for each separate heating, ventilating and air-conditioning system. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating or cooling input to each zone or floor, excluding unheated or uncooled basements and garages.

In all Group R, Division 1 Occupancies, each individual dwelling unit shall be considered separately and shall meet the above requirements for Group R, Division 3 Occupancies.

In all buildings and structures, or portions thereof, other than Group R, Division 3 Occupancies, and in spaces other than dwelling units in Group R, Division 1 Occupancies, at least one thermostat for regulation of space temperature shall be provided for each separate heating, ventilating and air-conditioning system and for each floor of the building.

(d) Setback and Shut Off. In all Group R, Division 3 Occupancies, the thermostat, or an alternative means such as a switch or a clock, shall provide a readily

accessible manual or automatic means for reducing the energy required for heating and cooling during periods of nonuse or reduced need.

In all other buildings and structures, or portions thereof, each heating, ventilating and air-conditioning system shall be equipped with a readily accessible means of reducing the energy used for heating, ventilating and air-conditioning during periods of nonuse or alternate uses of the building spaces or zones served by the system, such as with manually adjustable automatic timing devices, manual devices for use by operating personnel, or automatic control systems.

Lowering thermostat set points to reduce energy consumption of heating systems shall not cause energy to be expended to reach the reduced setting.

Sec. 1307. Piping for Steam and Hot Water Heating Systems. All piping serving as part of a heating or cooling system installed to serve buildings and within buildings shall be thermally insulated as shown in Table No. 13-G.

Insulation thicknesses are based on insulation having thermal resistance in the range of 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4 or may be reduced for materials having R values greater than 4.6 per inch of thickness as follows:

1. For materials with thermal resistance greater than R = 4.6, the minimum insulation thickness may be determined as follows:

$$\frac{4.6 \times \text{Table No. 13-G Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

2. For materials with thermal resistance less than R = 4.0, the minimum insulation thickness shall be determined as follows:

$$\frac{4.0 \times \text{Table No. 13-G Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

EXCEPTIONS: Piping insulation, except when needed to prevent condensation, is not required in any of the following cases:

1. Piping installed within heating, ventilating and air-conditioning equipment.
2. Piping operating at internal temperatures between 55°F and 120°F.
3. When the heat loss or heat gain of the piping, without insulation, does not increase the energy requirements of the building.

4. Piping installed in basements, cellars or unventilated crawl space with insulated walls in Group R, Division 3 Occupancies.

Where required to prevent condensation, insulation with vapor barriers shall be installed in addition to insulation required above.

Sec. 1308. Conservation of Hot Water.

(a) Showers. Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 3 gpm per shower head.

(b) Lavatories. Lavatories with hot water supplies in restrooms other than dwelling units in Group R Occupancies shall:

1. Be equipped with outlet devices which limit the flow of hot water to a maximum of 0.05 gpm, or

2. Be equipped with devices which limit the outlet temperature to maximum of 110°F, or

3. Be equipped with self-closing valves that limit delivery to a maximum of 0.25 gallons of hot water.

(c) Piping Insulation. Piping in return circulation systems shall be insulated so that heat loss is limited to a maximum of 17.5 Btu/h per linear foot of pipe. Maximum heat loss shall be determined at a temperature differential equal to the maximum water temperature minus a design ambient temperature not higher than 65°F.

EXCEPTION: Conformance with Table No. 13-G for low temperature piping systems shall be deemed as complying with this section.

(d) Pump Operation. Circulating hot water systems shall be arranged so that the circulating pump can be turned off either automatically or manually when the hot water system is not in operation.

(e) Performance Efficiency. All automatic electric storage water heaters shall have a stand-by loss not exceeding 4 watts per square foot of tank surface area. This method of determining stand-by loss shall be in accordance with acceptable engineering principles.

All gas and oil-fired automatic storage heaters shall have a recovery efficiency, ^{E}r, not less than 75 percent and a stand-by loss percentage, S, not exceeding $S = 2.3 + 67/V$, where V = volume in gallons. The method of determining ^{E}r and S shall be in accordance with acceptable engineering principles.

Service water heating equipment shall not be dependent on year-round operation of space heating

boilers, that is, boilers that have as another function winter space heating.

(f) Insulation. Unfired hot water storage tanks shall be insulated so that heat loss is limited to a maximum 13.6 Btu/h per square foot of external tank surface area. For purposes of determining this heat loss, the design ambient temperature shall be not higher than 65°F.

Sec. 1309. Controls. (a) Temperature Controls. All hot water supply systems shall be equipped with automatic temperature controls capable of adjustments from the lowest to the highest acceptable temperature settings for the intended use.

(b) Shut Down. A separate switch shall be provided to terminate the energy supplied to electric hot water supply systems. A separate valve shall be provided to turn off the energy supplied to the main burner of all other types of hot water supply systems.

Sec. 1310. Lighting power limit for buildings.

(a) General. This section establishes the maximum power limit for interior and exterior illumination systems.

(b) Exempt Buildings. Buildings housing Group R, Division 3 Occupancies, and the dwelling unit portion of buildings housing Group R, Division 1 Occupancies are exempt from the requirements of this section.

(c) Lighting Power Limit. A lighting power limit is the upper limit of the power to be available to provide the lighting needs of a building.

(d) Separate lighting power limit shall be calculated for the building interior and for the building exterior.

(e) Calculation Procedure. To establish a lighting power limit the following procedure shall be used:

1. Interiors.

A. Determine the use categories for the various parts of the building from Table No. 13-I.

B. Multiply the maximum power limit for each category by the gross floor area included in that category.

C. Add the total watts for each area to arrive at the lighting power limit for the building. Where ballasts are used, include wattage of ballasts.

D. In open-concept spaces in excess of 2,000 square feet, with no defined egress or circulation pattern, 25 percent of the area shall be designated as Category B.

2. Exteriors.

A. Category E lighting (see Table No. 13-I) - multiply the limit given in Table No. 13-I by the number of lineal feet in the building perimeter. Except for lighting required for security and safety, Category E lighting shall be off from 2:00 a.m. to 15 minutes before sunset.

B. Other exterior lighting - multiply the value in Category F in Table No. 13-I by the area to be illuminated.

3. Exception. Lighting for theatrical, television, cleanrooms, spectator sports and like performances shall not be included in the total building limit. Control of this lighting shall have limited access.

(f) Alternates.

1. The installed lighting power for any area may be increased or deceased from the values of Table No. 13-I provided the total interior building lighting power limit calculated in Section 1310(e) is not exceeded. The task lighting for any area shall not exceed the standards set forth in the latest edition of the Illuminating Engineering Society (IES) handbook incorporated by reference hereto.

2. Lighting for retail stores may use 5 watts per square foot for the first 500 square feet and 2.5 watts per square foot for floor area in excess of 500 square feet.

(g) Lighting Switching. In all exterior areas, lighting fixtures shall be switched automatically for nonoperation when natural light is available.

(h) Documentation. Lighting power loads shall be presented to the building official in an acceptable format and shall include the total connected lighting wattage per square foot for the entire structure.

(i) Application to Existing Buildings.

1. General. The provisions of this section shall apply to all existing buildings and structures with a gross floor area in excess of 10,000 square feet.

2. Exempt Buildings and Lighting. The following are exempt from the provisions of this section:

A. Buildings housing Group R, Division 3 Occupancies and the dwelling unit portion of buildings housing Group R, Division 1 Occupancies.

B. The manufacturing portion of industrial plants.

C. Exterior lighting, provided that Section 1310(g) shall apply to exterior lighting for existing buildings or portions of existing buildings not exempt under subsections A and B above.

3. Existing Buildings. For the purposes of this section, existing buildings shall be as defined under section 203 of this code.

4. Calculation Procedure. Lighting power limit for existing buildings shall be established following procedure set forth in Section 1310(e).

5. Alternates. The alternates set forth in Section 1310(f) shall also be applicable to existing buildings.

6. Documentation. Lighting power loads shall be presented to the building official in an acceptable format and shall include the total connected lighting wattage per square foot for the portion of a structure under consideration.

Sec. 1311. Energy Conservation in Electrical Distribution Systems.

(a) Power Factor. The power factor of the overall electrical distribution system in a building shall be not less than 90 percent under rated design installed load of the building, either by utilizing equipment design or by the use of power factor corrective devices. The corrective methods shall be based upon an engineering evaluation of each distribution system.

(b) Lighting Switching. Switching shall be provided for each lighting circuit, or for portions of each circuit so that the partial lighting required for custodial or for effective complementary use with natural lighting may be operated selectively.

(c) Separate Metering. In all Group H Occupancies, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

TABLE NO. 13-A - CRITERIA FOR GROUP R OCCUPANCY BUILDINGS THREE STORIES OR LESS IN HEIGHT

ELEMENT	MODE	U_o
Walls	Cooling	0.47
Roof/Ceiling	Heating &	0.06
Roof w/o Ceiling*	Cooling	0.15
Floors Over Unheated Spaces	Heating	0.47

*Use this when a ceiling air plenum is involved.

TABLE NO. 13-B - CRITERIA FOR BUILDINGS OTHER THAN GROUP R OCCUPANCY THREE STORIES OR LESS IN HEIGHT

ELEMENT	MODE	U_o	OTTV
Walls	Heating	0.47	
	Cooling		28.5
Roof/Ceiling	Heating &	0.06	
Roof w/o Ceiling*	Cooling	0.15	
Floors Over Unheated Spaces	Heating	0.47	

*Use this when a ceiling air plenum is involved.

TABLE NO. 13-C - MINIMUM EER AND COP FOR ELECTRICALLY DRIVEN AIR-CONDITIONING SYSTEM EQUIPMENT

STANDARD RATING CAPACITY	Air Cooled		Water or Evap. Cooled	
	EER	COP	EER	COP
Under 65,000 Btu/hr (19 kilowatts)	7.8	2.28	8.8	2.58
65,000 Btu/hr (19 kilowatts and over)	8.2	2.40	9.2	2.69

TABLE NO. 13-D - MINIMUM AND COP FOR HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEM HEAT OPERATED COOLING EQUIPMENT

HEAT SOURCE	MINIMUM COP
Direct fired (gas, oil)	0.48
Indirect fired (steam, hot water)	0.68

TABLE NO. 13-E - MINIMUM COP FOR ELECTRICALLY DRIVEN AIR-CONDITIONING SYSTEM COMPONENTS

COMPONENT	CONDENSING MEANS	AIR		WATER		EVAPORATOR	
		EER	COP	EER	COP	R	COP
Self-contained Water Chillers	Centrifugal	8.0	2.34	13.8	4.04		
	Positive Displacement	8.4	2.46	12.0	3.51		
Condenserless Water Chillers	Positive Displacement	9.9	2.90	12.0	3.51		
Condensing Units 65,000 Btu/hr (19 kilowatts) and over	Positive Displacement	9.5	2.78	12.5	3.66	12.5	3.66

TABLE NO. 13-F - MINIMUM COP FOR HEAT PUMPS, HEATING MODE

SOURCE AND OUTDOOR TEMPERATURE, °F	MINIMUM COP
Air Source - 47 dB/43WB	2.7
Air Source - 17 dB/15WB	1.8
Water Source - 60 Entering	3.0

TABLE NO. 13-G - MINIMUM PIPE INSULATION

Piping System Types	Fluid Temperature Range, °F	INSULATION THICKNESS IN INCHES FOR PIPE SIZES					
		Run-outs Up to 2"	1" and Less	1-1/4 to 2"	2-1/2 to 4"	5" & 6"	8" & Larger
Heating System Steam and Hot Water							
High Pressure/Temp	306-450	1-1/2	2-1/2	2-1/2	3	3-1/2	3-1/2
Med. Pressure/Temp	251-305	1-1/2	2	2-1/2	2-1/2	3	3
Low Pressure/Temp	201-250	1	1-1/2	1-1/2	2	2	2
Low Temperature	120-200	½	1	1	1-1/2	1-1/2	1-1/2
Steam Condensate (for Feed Water)	Any	1	1	1-1/2	2	2	2
Cooling Systems Chilled Water, Refrigerant or Brine	40-55	½	½	3/4	1	1	1
	Below 40	1	1	1-1/2	1-1/2	1-1/2	1-1/2

TABLE 13-H - TEMPERATURE DIFFERENCE FOR SUNLIT WALLS*

WALL CONSTRUCTION MASS PER UNIT AREA - lbs/ft^2	TD_{EQ}-°F
0-25	44
26-40	37
41-70	30
71 and above	23

*Temperature difference for shaded areas need be no greater than the average difference between ambient and inside conditions.

TABLE NO. 13-I - LIGHTING LIMIT (CONNECTED LOAD)
FOR LISTED OCCUPANCIES

TYPE OF USE	MAX. LIMIT PER SQ. FT. (WATTS)
INTERIOR	
Category A: Classroom, office, automotive, mechanical area, museum, conference room, drafting, clerical, laboratory, retail stores, manufacturing, process, industrial, kitchen, examining room, open library stacks, athletic facility	3
Category B: Auditorium, place of assembly, waiting area, spectator area, restroom, dining, working corridor in prison and hospital, transportation terminal, closed book stacks, active storage, hospital bedroom, hotel/ motel bedroom, enclosed shopping mall concourse	1
Category C: Corridor, lobby, elevator, stairway, dead storage, bulk manufacturing	.5
Category D: Indoor parking	.25
EXTERIOR	
Category E: Building perimeter: Wall-wash, facade, canopy	5 (per linear foot)
Category F: Outdoor parking"]	0.05

SECTION 2. The "Hawaii Model Energy Code, Energy Efficiency Standard for Buildings, July 1993, Prepared for: Energy Division, Department of Business, Economic Development & Tourism, State of Hawaii, Prepared by: Eley Associates, 142 Minna Street, San Francisco, California 94105," is hereby incorporated herein by

reference and made a part hereof and adopted, subject to the provisions of Chapter 16.16, Maui County Code, as hereinafter enacted and as hereafter may be amended.

SECTION 3. Title 16, Maui County Code, is amended by adding a new chapter 16.16, to be appropriately designated and to read as follows:

"**Chapter 16.16**

ENERGY CODE

Sections:

16.16.010 Section 1 added. Article 1, Hawaii Model Energy Code, is amended by adding a new section 1 to be designated and to read as follows:

Sec. 1 The Hawaii Model Energy Code, incorporated.
The "Hawaii Model Energy Code, Energy Efficiency Standard for Buildings, July 1993, Prepared for: Energy Division, Department of Business, Economic Development & Tourism, State of Hawaii, Prepared by: Eley Associates, 142 Minna Street, San Francisco, California 94105," is incorporated by reference and made a part hereof, subject to the amendments set forth in this chapter.

16.16.020 Section 2.1 amended. Section 2.1, Hawaii Model Energy Code, is amended to read as follows:

Sec. 2.1 Applicability of Code.
This Code sets forth design requirements for the efficient use of energy in new buildings and new construction in existing buildings; provided that the standards for renovated buildings shall apply only to that portion of a building being renovated and only to that section of the system or the elements in the renovated portion of the building, as further defined in this Code. This Code applies to buildings or portions of buildings that provide facilities or shelter for human occupancy including shell and speculative buildings. The requirements apply to building envelope; distribution of energy; and systems and equipment for ventilating, air conditioning, service water heating, lighting, and energy managing.

16.16.030 Section 2.2 amended. Section 2.2, Hawaii Model Energy Code, is amended to read as follows:

Sec. 2.2 When Code not applicable.
This Code does not apply to:
(1) Areas of buildings intended primarily for manufacturing or for commercial or industrial processing;
(2) Buildings or separately enclosed identifiable areas having any combination of dedicated space heating, service water heating, ventilating, air conditioning and lighting systems whose combined peak design rate of nonrenewable energy usage for these purposes is less than 1.0 watt/ft^2 or 3.413 Btu/h-ft^2 of gross floor area. Site-generated wind, hydro or solar electric power is exempt; **[**and**]**
(3) Buildings of fewer than 100 ft^2 of gross floor area;
(4) Low-rise residential buildings as exempted under ASHRAE 90.1, except as provided in Article 14;

(5) Existing buildings that were previously permitted, inspected, and approved that are being relocated in their entirety;

(6) Any work being performed on lands that are designated by the state land use commission to be within the conservation district or are designated as Hawaiian Home Lands; and

(7) Any work being performed on behalf of any federal agency.

16.16.040 Section 2.5 added. Article 2, Hawaii Model Energy Code, is amended by adding a new section 2.5 to be designated and to read as follows:

Sec. 2.5 Rules.

The director may adopt administrative rules for the implementation, administration, and enforcement of this chapter.

16.16.050 Section 3.1 amended. Section 3.1, Hawaii Model Energy Code, is amended by adding the following definitions to be appropriately inserted and to read as follows:

director: the director of public works and environmental management or the director's duly authorized representative.

factory-built structure: any structure that is manufactured or fabricated at a place other than the building site.

16.16.060 Section 4.4 amended. Section 4.4, Hawaii Model Energy Code, is amended to read as follows:

Sec. 4.4 Requirements.

(a) Basic requirements. All building designs shall meet the requirements of Sections 5.3, 6.3, 8.3, 9.3, 10.3 and 11.3 of this Code.

(b) Prescriptive and/or system performance criteria. In addition to the basic requirements of subsection (a), either the requirements of this subsection, the Prescriptive and/or System Performance criteria, or of subsection (c), the Cost Budget Method, shall be met.

(1) The lighting design shall meet either the Prescriptive Criteria of Section 6.4 or the Systems Performance Criteria of Section 6.5;

(2) The roof of the building envelope shall meet the Prescriptive Criteria of Section 8.4. Walls may meet either the Prescriptive Criteria of

Section 8.4 or the Systems Performance Criteria of Section 8.5;

(3) The heating, ventilating and air conditioning systems design shall meet the Prescriptive Criteria of Section 9.4; [and]

(4) The service water heating systems and equipment design shall meet the prescriptive criteria of Section 11.3.; and

(c) Building energy cost budget method. The Building Energy Cost Budget Method (Article 13) may be used instead of the Prescriptive and/or System Performance Criteria of subsection (b).

(d) Plans and specifications. [Plans,] When plans, specifications and necessary computations [shall be submitted to indicate compliance with the Code. Plans] must be submitted for any permit required by chapters 16.18A, 16.20A, or 16.26, Maui County Code, those plans and specifications [for work to] shall comply with this Code and shall be prepared, designed, or approved by a [duly registered] licensed professional engineer or architect as required by Chapter 464 of the Hawaii Revised Statutes. The responsible design professional shall seal or wet stamp the plans and first page of separate specifications and shall provide a signed statement certifying that the project is in compliance with this chapter. The signed statement shall be submitted to the director prior to issuance of any applicable permit required by chapters 16.18A, 16.20A, and 16.26, Maui County Code.

16.16.070 Section 4.5 added. Article 4, Hawaii Model Energy Code, is amended by adding a new section 4.5 to be designated and to read as follows:

Sec. 4.5 Administration and enforcement.

Sections 16.26.103 and 16.26.104, Maui County Code, shall apply to this chapter. Any person aggrieved by a decision of the director may appeal to the board of variances and appeals pursuant to section 19.530.030(C), Maui County Code.

16.16.080 Section 5.3 amended. Section 5.3, Hawaii Model Energy Code, is amended to read as follows:

Sec. 5.3 Basic requirements.

(a) Electrical distribution system. The design of building electrical distribution systems whose connected

electric load is over 250 kVA shall include provisions for check-metering of electrical energy consumption.

(1) Electrical power feeders.

(A) The electrical power feeders for each facility for which provision for check-metering is required shall be subdivided in accordance with the following categories:

(i) Lighting and receptacle outlets;

(ii) HVAC systems and equipment;

(iii) SWH, elevators, and special-occupant equipment or systems of more than 20 kW such as computer rooms, kitchens, printing equipment, and baling presses.

(B) Exception.

10% or less of the loads on a feeder may be from another usage category.

(2) In multiple-tenant buildings, provision to permit check-metering of the tenant load shall be provided for those tenants having a connected load of 100 kVA or more. HVAC or SWH systems shared by tenants in common need not meet this tenant check-metering requirement but shall be separately metered as required.

(3) The feeders for each category in subsection (1) shall contain provisions for portable or permanent check-metering.

(4) The minimum acceptable arrangement for compliance with subsection (a) shall provide a safe method for access by qualified persons to the enclosures through which feeder conductors pass, and shall provide sufficient space to attach clamp-on or split-core current transformers. These enclosures may be separate compartments or combined spaces with electrical cabinets serving another function. Dedicated enclosures so furnished shall be identified as to measuring function available. A preferred arrangement would include kWh meters and demand registers or a means to transmit such information to the building energy management control system. These points of measurement may be centrally located or distributed through the building, as appropriate.

(b) Electrical motors.

(1) Design A & B squirrel cage, foot mounted, T-frame induction motors of 1 hp or more having synchronous speeds of 3600, 1800, 1200 and 900 rpm

expected to operate more than 500 hours per year shall have a nominal full-load motor efficiency no less than that shown in Table 5-1 or shall be classified under the National Electric Manufacturers Association's Standard as "energy efficient" [*NEMA Standards Publication [No. MG 1-1987, Revision No 2. - May and November 1989, September and November 1990, January and February 1991,]* *No. MG 1-1993, Motors and Generators*, National Electrical Manufacturers Association, Washington, D. C. 20037]. Other motor types are exempted from the efficiency requirements of this standard.

(2) Exceptions.

(A) Motors used in systems designed to use more than one speed of a multi-speed motor; and

(B) Motors used as a component of the equipment meeting the minimum equipment efficiency requirements of Article 10 provided that the motor input is included when determining the equipment efficiency.

(c) Operation and maintenance information. A manual which provides basic data relating to the design, operation, and maintenance of the building electrical distribution system shall be provided to building owners by the installer of the electrical distribution system. The manual shall include:

(1) A single-line diagram of the "as-built" building electrical distribution system;

(2) Schematic diagrams of electrical control systems (other than HVAC, which are covered in Article 9 elsewhere); and

(3) Manufacturer's operational and maintenance information for electrical equipment.

(d) Energy conservation in electrical distribution systems. The power factor of the overall electrical distribution system in a building shall be not less than 90% under the rated design installed load of the building, either by utilizing equipment design or by the use of power factor corrective devices. The selection of equipment or use of power factor corrective devices shall be based upon an engineering evaluation of each distribution system.

(e) Distribution transformers.

(1) Low-voltage dry-type distribution transformers shall meet the minimum efficiency requirements listed in Table 5-2. These

transformers are air-cooled units with input voltage of 600 volts or less that typically convert a source voltage of 480/277 volts to an output of 208/120 volts.

(2) Exceptions.

(A) Transformers with rated output capacity less than 15 kVA;

(B) Drive transformers;

(C) Rectifier and converter transformers;

(D) Autotransformers;

(E) Sealed and nonventilated transformers;

(F) Welding transformers;

(G) Transformers with tap ranges greater than 10%;

(H) Testing transformers;

(I) Furnace transformers; and

(J) Instrument transformers.

16.16.090 Table 5-2 added. Article 5, Hawaii Model Energy Code, is amended by adding a new Table 5-2 to be designated and to read as follows:

Table 5-2 Standards for Distribution Transformers

Single Phase		Three Phase	
Rated Power Output kVA	Minimum Efficiency %	Rated Power Output kVA	Minimum Efficiency %
15	97.7	15	97.0
25	98.0	30	97.5
37.5	98.2	45	97.7
50	98.3	75	98.0
75	98.5	112.5	98.2
100	98.6	150	98.3
167	98.7	225	98.5
250	98.8	300	98.6
333	98.9	500	98.7
=	=	750	98.8
=	=	1000	98.9

16.16.100 Table 6-1 deleted; new Table 6-1.1 added. Table 6-1, Hawaii Model Energy Code, is deleted and adding a new Table 6-1.1 to be designated and to read as follows:

Table 6-1.1 Exterior Lighting Unit Power Allowances

Area Description	Allowance
Exit (with or without canopy)	20 Watts/linear foot of door opening
Entrance (without canopy)	30 Watts/linear feet of door opening
Entrance (with canopy) High Traffic (retail, hotels, airports, theater, etc.)	10 Watts/square foot of canopied area
Entrance (with canopy) Light Traffic (hospital, office, school, etc.)	4 Watts/square foot of canopied area

Loading area	0.40 Watt/square foot
Loading door	20 Watts/linear foot of door opening
Building exterior surfaces/facades	0.25 Watt/square foot of surface to be illuminated
Storage and non-manufacturing work areas	0.20 Watt/square foot
Other activity areas for casual use, such as picnic grounds, gardens, parks, and other landscaped areas	0.10 Watt/square foot
Private driveways and walkways	0.10 Watt/square foot
Public driveways and walkways	0.15 Watt/square foot
Private parking lots	0.12 Watt/square foot
Public parking lots	0.10 Watt/square foot
Outdoor retail (auto sales, etc.)	0.40 Watt/square foot
Service Station, under canopy	0.60 Watt/square foot

16.16.110 Subsection 6.3(a) amended. Section 6.3, Model Energy Code, is amended by amending subsection 6.3(a) to read as follows:

(a) Lighting power allowance. A building or facility total lighting allowance consists of the exterior lighting power allowance (ELPA), and the interior lighting power allowance (ILPA).

ELPA shall be calculated using the exterior lighting unit power allowances in Table [6-1] 6-1.1. ILPA shall be calculated in accordance with the Prescriptive criteria in Section 6.4 or the System Performance criteria in Section 6.5.

(1) Compliance. A building shall be considered in compliance with subsection (a) if the following conditions are met:

(A) The exterior lighting power to be installed is not greater than the ELPA, based on Table [6-1] 6-1.1; and

(B) The interior lighting power to be installed is not greater than the ILPA, based on either the Prescriptive criteria in Section 6.4 or the System Performance criteria in Section 6.5.

(2) Tradeoffs between ILPA and ELPA are not allowed. Tradeoffs of the interior lighting power budgets (LPB) among interior spaces (see Section 6.5) are allowed as long as the CLP of interior lighting does not exceed the ILPA. Tradeoffs of the exterior lighting power budgets among exterior areas are allowed as long as the CLP of exterior lighting does not exceed the ELPA.

(3) When determining lighting power compliance, the amount of power required for lights automatically controlled using functions such as daylight sensing control, occupancy sensor, lumen maintenance control, and programmable timing control may be reduced by a power adjustment factor (PAF) determined in accordance with subsection (c).

(4) Compliance for a multi-building facility. The total lighting power allowance for each building in a multi-building facility shall be calculated separately. Tradeoffs among the buildings shall be restricted as follows:

(A) Tradeoffs of ELPA are allowed;

(B) Tradeoffs of ILPA are not allowed; and

(C) Tradeoffs between ILPA and ELPA are not allowed.

(5) Luminaire wattage. Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

(A) The wattage of incandescent or tungsten-halogen luminaries with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.

(B) The wattage of luminaries with permanently installed or remotely installed ballasts shall be the operating input wattage

of the specified lamp/ballast combination based on values from manufacturers catalogs or values from independent testing laboratory reports.

(C) The wattage of a line-voltage lighting track and plug-in busway that allow the addition and/or relocation of luminaries without altering the wiring of the system shall be the specified wattage of the luminaries included in the system with a minimum of 30 watts/linear foot (98 watts/linear meter).

(D) The wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow the addition and/or relocation of luminaries without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.

(E) The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.

(6) Exterior building grounds lighting. All exterior building grounds luminaries that operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lumens/watt unless the luminaire is controlled by a motion sensor or the application is otherwise exempted from this code.

16.16.120 Subsection 6.3(e) added. Section 6.3, Hawaii Model Energy Code, is amended by adding a new subsection (e) to be designated and to read as follows:

(e) Illuminated exit signs.

The input power of illuminated exit signs shall be no greater than 5 watts per face.

16.16.130 Subsection 8.3(g) amended. Section 8.3, Hawaii Model Energy Code, is amended by adding a new subsection (g) to be designated and to read as follows:

(g) Radiant barrier eligibility. To qualify for the radiant barrier credit (RB) described in subsection (f), the installation of the radiant barrier **[**must**]** shall meet the following criteria:

(1) The emissivity of the radiant barrier shall be less than or equal to 0.10. The

manufacturer shall provide test data or documentation of the emissivity using ASTM E-408, Test Method For Total Normal Emittances of Surfaces Using Inspection Meter Techniques, ASTM Philadelphia, PA 19103.

(2) The radiant barrier shall be securely installed in a permanent manner using one of the following [four] five installation methods.

(A) Draped with the shiny side facing down over the top cord of the truss before the roof deck is installed. A minimum air gap of ¾ inch must be provided between the radiant barrier and the roof deck above at the center of the span. A minimum ¾ inch air gap [must] shall also be provided between the radiant barrier and the ceiling or insulation below.

(B) Stretched with the shiny side facing down between the top cords of the truss and stapled or otherwise secured at each side. A minimum air space of ¾ inch above and below is required.

(C) Stapled or otherwise secured to the bottom surface of the top cord of the truss and draped below with the shiny side facing down. For attic installations only. A minimum air space of ¾ [inches] inch above and below is required.

(D) Laid on top of the roof deck with the shiny side facing up and a minimum ¾ inch air gap between the radiant barrier and the roofing material above. For open beam ceiling construction only. The roof slope shall be greater than or equal to 14° from horizontal.

(E) Laminated to the underside of the roof sheathing with at least ¾ inch air space below.

(3) At least one square foot of free area for ventilation shall be provided per 150 square feet of attic floor area, or in the case of vaulted or open beam ceilings, per 150 square feet of ceiling area. In vaulted or open beam ceilings, the air space shall be vented with vent area approximately evenly distributed between the top and the bottom. In vaulted ceilings, vents shall be provided for each air space between rafters.

16.16.140 Subsection 8.4(c) amended. Section 8.4, Hawaii Model Energy Code, is amended by amending subsection (c) to read as follows:

(c) Vertical glazing.

(1) The Relative Solar Heat Gain (RSHG) of vertical fenestration, as defined in subsection 8.3(d), shall be less than or equal to the appropriate value in Table 8-5 for low-rise buildings and Table 8-6 for all others. The maximum RSHG for north orientations shall be based on the window-to-wall ratio (WWR) for north-facing walls. The maximum RSHG for all other orientations shall be based on the combined WWR for east, west and south walls. Linear interpolation may be used to determine the maximum allowed RSHG for WWR's which lie within one of the ranges.

(2) Exceptions.

(A) A window area of up to 2 [percent] % of gross exterior wall area may exceed the RSHG limits for any given orientation;

(B) Low-rise residential buildings which are not air-conditioned are exempt from the RSHG limits;

(C) [Low-rise residential buildings in locations with greater than 800 Heating Degree Days (base 65°F) or with elevation greater than 2,500 feet above sea level (where degree day data are not available) are exempt from the RSHG limits;] Individual windows completely shaded from the sun are exempt from the RSHG limits and shall be excluded from the window area calculation;

(D) Individual windows may exceed the maximum RSHG limit as long as the area-weighted average RSHG's for both the north orientation and the combined east, west and south orientations are less than or equal to the maximum limit.

16.16.150 Subsection 9.3(a) amended. Section 9.3, Hawaii Model Energy Code, is amended by amending subsection (a) to read as follows:

(a) Load calculations.

(1) Calculation Procedures.

(A) Cooling system design loads for the purpose of sizing systems and equipment shall

be determined in accordance with the procedures described in the ASHRAE Handbook, 1989 Fundamentals or a similar computation procedure. For those design parameters addressed in (2) through (9), the values specified shall be used.

(B) Exceptions.

(i) Design load calculations are not required to be submitted for new, individually permitted, cooling systems of less than 65,000 Btu per hour capacity that provide less than 37 Btu per hour of installed capacity per square foot of conditioned floor area.

(ii) Design load calculations are not required to be submitted when existing cooling equipment is replaced with equipment of equal or less capacity.

(2) Indoor Design Conditions. Indoor design temperature and humidity conditions for general comfort applications shall be in accordance with the comfort criteria established in ANSI/ASHRAE Standard 55-1981 Thermal Environmental Conditions for Human Occupancy, or Chapter 8 of the ASHRAE Handbook, 1989 Fundamentals, or both, except that winter humidification and summer dehumidification are not required.

(3) Outdoor Design Conditions. Outdoor design conditions shall be selected from "Climatic Data for Region X Arizona, California, Hawaii, Nevada", Golden Gate and Southern California Chapters, ASHRAE, Fifth Edition, May 1982, or from data obtained from the National Climatic Center or a similar recognized weather data source. Cooling design temperatures shall be no greater than the 0.5% annualized value.

(4) Ventilation. Outdoor air ventilation loads shall be based on ventilation rates specified in subsection 9.3(f).

(5) Envelope. Envelope cooling loads shall be based on envelope characteristics, such as thermal conductance, shading coefficient, and air leakage, consistent with the values used to demonstrate compliance with Article 8.

(6) Lighting. Lighting loads shall be based on actual design lighting levels or power budgets consistent with Article 6.

(7) Other Loads. Other HVAC system loads, such as those due to people and equipment, shall be based on design data compiled from one or more of the following sources:

(A) Actual information based on the intended use of the building;

(B) Published data from manufacturers' technical publications;

(C) Technical society publications such as the ASHRAE Handbooks, 1991 HVAC Applications and 1992 HVAC Systems and Equipment;

(D) Alereza, "Estimates of recommended heat gains due to commercial appliances and equipment", ASHRAE *Transactions*, Vol. 90, Pt 2A, pp. 25-58, 1984.

(E) Default values to be used in determining the design energy budget in Article 13 are taken from Tables 13-2, 13-3, 13-3A, 13-4 and 13-6;

(F) Other data based on designer's experience of loads and occupancy patterns.

(8) Safety Factor. Design loads may, at the designer's option, be increased by as much as 10% to account for unexpected loads or changes in space usage.

(9) Pick-up Loads. Transient loads such as cool-down loads which occur after off-hour setback or shutoff, may be calculated from basic principles, based on the heat capacity of the building and its contents, the level of setback, and desired recovery time, or may be assumed to be up to 10% of the steady-state cooling design loads. The steady-state load may include a safety factor in accordance with subsection (8).

16.16.160 Subsection 9.3(i) amended. Section 9.3, Hawaii Model Energy Code, is amended by amending subsection (i) to read as follows:

(i) Completion requirements.

(1) Operating and maintenance manual. An operating and maintenance manual shall be provided to the building owner. The manual shall include basic data relating to the operation and maintenance of HVAC systems and equipment. Required routine maintenance actions shall be clearly identified. Where applicable, HVAC control

information such as diagrams, schematics, control sequence descriptions, and maintenance and calibration information shall be included.

(2) Air system balancing.

(A) Air system balancing shall be accomplished in a manner to first minimize throttling losses, then fan speed shall be adjusted to meet design flow conditions. Balancing procedures shall be in accordance with those established by the National Environmental Balancing Bureau (NEBB) Procedural Standards (1983), the Association of Air Balancing Council (AABC) National Standards (1982), or equivalent procedures.

(B) Exception.

Damper throttling may be used for air system balancing with fan motors of 1 hp or less, or if throttling results in no greater than 1/3 hp fan horsepower draw above that required if the fan speed were adjusted.

(3) Hydronic system balancing.

(A) Hydronic system balancing shall be accomplished in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet flow conditions.

(B) Exceptions.

Valve throttling may be used for hydronic system balancing under any of the following conditions:

(i) Pumps with pump motors of 10 hp or less;

(ii) If throttling results in no greater than three (3) pump horsepower draw above that required if the impeller were trimmed;

(iii) To reserve additional pump pressure capability in open-circuit piping systems subject to fouling. Valve throttling pressure drop shall not exceed that expected for future fouling;

(iv) Where it can be shown that throttling will not increase overall building energy costs.

[(4) HVAC control systems shall be tested to assure that control elements are calibrated, adjusted, and in proper working condition.]

16.16.170 Subsection 9.3(k) added. Section 9.3, Hawaii Model Energy Code, is amended by adding a new subsection (k) to be designated and to read as follows:

(k) System commissioning.

(1) HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition.

(2) For projects larger than 50,000 square feet (4,600 square meters) of conditioned area, detailed instructions for commissioning HVAC systems shall be provided by the designer in plans and specifications.

16.16.180 Subsection 9.4(f) added. Section 9.4, Hawaii Model Energy Code, is amended by adding a new subsection (f) to be designated and to read as follows:

(f) Kitchen hoods.

(1) Individual kitchen exhaust hoods larger than 5,000 cubic feet/minute (2,500 liters/second) shall be provided with make-up air sized for at least 50% of exhaust air volume that is uncooled or cooled without the use of mechanical cooling.

(2) Exceptions:

(A) Where hoods are used to exhaust ventilation air which would otherwise exfiltrate or be exhausted by other fan systems.

(B) Certified grease extractor hoods that require a face velocity no greater than 60 feet/minute (18 meters/second).

16.16.190 Section 10.3 deleted; new Section 10.3.1 added. Section 10.3, Hawaii Model Energy Code, is deleted and adding a new section 10.3.1 to be designated and to read as follows:

Sec. 10.3.1 Basic requirements.

(a) Mechanical equipment efficiency.

(1) Equipment shown in ASHRAE Tables 6.2.1A through 6.2.1G shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Omission of minimum performance requirements for equipment not listed in ASHRAE Tables 6.2.1A through 6.2.1G does not preclude use of such equipment. Equipment not listed in ASHRAE Tables

6.2.1A through 6.2.1G shall have no minimum performance requirements. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all requirements, unless otherwise exempted by footnotes in the table. However, equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum efficiency requirements for operation at minimum capacity or other than standard rating conditions. Equipment used to provide water heating functions as part of a combination system shall satisfy all stated requirements for the appropriate space heating or cooling category.

(2) If a certification program exists for a product covered in ASHRAE Tables 6.2.1A through 6.2.1G, and it includes provisions for verification and challenge of equipment efficiency ratings, the product shall be either listed in the certification program or, alternatively, the ratings shall be verified by an independent laboratory test report. If no certification program exists for a product covered in ASHRAE Tables 6.2.1A through 6.2.1G, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where components such as indoor or outdoor coils from different manufacturers are used, the system designer shall specify component efficiencies whose combined efficiency meets the minimum equipment efficiency requirements in this article.

(3) ASHRAE Tables 6.2.1A through 6.2.1G set forth the minimum efficiency requirements for equipment covered by this section. The tables are organized to cover the following types of equipment:

(A)	Table 6.2.1A	Air conditioners and condensing units;
(B)	Table 6.2.1B	Heat pumps;
(C)	Table 6.2.1C	Water chilling packages;
(D)	Table 6.2.1D	Packaged terminal and room air conditioners and heat pumps;

(E) Table 6.2.1E furnaces, duct furnaces, and unit heaters;
(F) Table 6.2.1F boilers; and
(G) Table 6.2.1G heat rejection equipment.

(4) Gas-fired and oil-fired forced air furnaces with input ratings greater than or equal to 225,000 Btu/hour (65 kilowatts) shall also have an intermittent ignition or interrupted device (IID), and have either power venting or a flue damper. A vent damper shall be an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings greater than or equal to 225,000 Btu/hour (65 kilowatts), including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75% of the input rating.

(5) Exceptions:

(A) Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI standard 550 test conditions (and thus cannot be tested to meet the requirements of ASHRAE Table 6.2.1C) of 44°F leaving chilled water temperature and 85°F entering condenser water temperature shall have a minimum full load coefficient of performance and IPLV rating as shown in ASHRAE Tables 6.2.1H through 6.2.1J. The table values are only applicable over the following full load design temperature ranges:

(i) Leaving chiller water: 40°F to 48°F;
(ii) Entering condenser water: 75°F to 85°F; and
(iii) Condensing water rise: 5°F to 15°F.

(B) Chillers designed to operate outside of these ranges are not covered by this standard.

(b) Maintenance. Operation and maintenance information shall be provided with the equipment by the equipment supplier.

16.16.200 Tables 10-1, 10-2, 10-3, 10-4a, 10-4b, 10-6, and 10-7 deleted; new Section 10.4 added. Tables 10-1, 10-2, 10-3, 10-4a, 10-4b, 10-6, and 10-7, Hawaii Model Energy Code, are deleted and adding a new section 10.4 to be designated and to read as follows:

Sec. 10.4 Tables.

ASHRAE Standard 90.1-1999, Tables 6.2.1A, 6.2.1B, 6.2.1C, 6.2.1D, 6.2.1E, 6.2.1F, 6.2.1G, 6.2.1H, 6.2.1I, and 6.2.1J are incorporated herein by reference and amended by deleting column titled "Minimum Efficiency" and changing the column heading "Efficiency as of 10/29/01" to read "Minimum Efficiency."

16.16.210 Subsection 11.3(k) added. Section 11.3, Hawaii Model Energy Code, is amended by adding a new subsection (k) to be designated and to read as follows:

(k) Heat traps.

Vertical pipe risers serving storage water heaters and storage tanks not having integral heat traps and serving a nonrecirculating system shall have heat traps on both the inlet and outlet piping as close as practicable to the storage tank. A heat trap is a means to counteract the natural convection of heated water in a vertical pipe run. The means is either a device specifically designed for the purpose or an arrangement of tubing that forms a loop of 360° or piping that from the point of connection to the water heater (inlet or outlet) includes a length of piping directed downwards before connection to the vertical piping of the supply water or hot water distribution system, as applicable.

16.16.220 Article 14 added. The Hawaii Model Energy Code is amended by adding a new Article 14 to be designated and to read as follows:

ARTICLE 14. LOW-RISE RESIDENTIAL ROOF HEAT GAIN REQUIREMENTS

Sec. 14.1 Scope.

(a) Notwithstanding Section 2.1, the requirements of this article shall apply to new low-rise residential buildings and new construction in existing low-rise residential buildings consisting of enclosed, habitable additions where the additions are 100 square feet or larger.

(b) "Roofs" shall mean the same as is defined in Section 3.1.

Sec. 14.2 Low-rise residential roof heat gain requirements.

(a) The opaque portions of roof assemblies shall include at least one of the following:

(1) R-19 insulation between roof or ceiling framing members;

(2) Two inches of foam board insulation;

(3) A radiant barrier, as provided in subsection (d) and ventilation as provided in subsection (c);

(4) A cool roof as provided in subsection (e) and a radiant barrier as provided in subsection (d); or

(5) Any construction that meets the opaque roof heat gain requirements of Section 8.4(a).

(b) Plans shall indicate insulation type, thickness, and location; ventilation opening types, sizes and locations; radiant barrier location; and roof surface type as appropriate, depending on the compliance option selected from subsection (a).

(c) Additional ventilation of the space containing a radiant barrier for compliance with subsection (a)(3) shall be provided by at least one of the following:

(1) A baffled ridge vent installed in accordance with the manufacturer's instructions in addition to lower inlet openings to provide a total of no less than 1 square foot of net free vent area for each 300 square feet of roof area. No less than 30% of the total vent area shall be in either the ridge vent or the lower half of the ventilated space.

(2) A solar-powered exhaust fan that provides at least 1 cubic foot per minute of airflow for each square foot of roof area.

(3) Upper and lower vents with total net free vent area of at least 1 square foot for each 150 square feet of roof area. At least 30% of the total vent area shall be in the upper half of the ventilated space and at least 30% of the total vent area shall be in the lower half of the ventilated space.

(d) A radiant barrier used for compliance with subsections (a)(3) or (a)(4) shall have an emissivity of no greater than 0.05 as tested per ASTM E-408, Test Method for Total Normal Emittances of Surfaces Using Inspection Meter Techniques (manufacturer's test results

are acceptable). The radiant barrier shall be installed with the shiny side facing down and with a minimum air gap thickness of 3/4 inch below. The radiant barrier may be securely attached to the roof framing or may be laminated to the bottom of the roof sheathing. A radiant barrier is a sheet of material with a low emissivity on at least one side that is used to reduce radiant heat transfer. Radiant barriers typically have a shiny metallic appearance.

(e) A cool roof for purposes of compliance with subsection (a)(4) shall have a total solar reflectance when tested according to ASTM E-903 of no less than 0.70. The infrared emittance using ASTM E-408 shall be no less than 0.75. The manufacturer's test results shall be acceptable for compliance. A cool roof has both a light color (high solar reflectance) and a high emittance (can reject heat back to the environment). White painted surfaces and other smooth white coatings typically meet these requirements. Surfaces that do not meet the requirements include unpainted metal and most metalized roof coatings (silver appearance).

(f) At building sites higher than a 2,400-foot elevation, only subsections (a)(1) or (a)(2) shall be acceptable for compliance.

(g) For the purpose of this section, "net free vent area" means the total area through which air can pass in a screen, grille face or register.

(h) For the purpose of this section, "roof area" means attic floor area; or, if there is no attic, "roof area" means the horizontal projection of roof area measured from the outside surface of the exterior walls."

SECTION 4. If any provision of this ordinance, or the application thereof to any person or circumstance shall for any reason be held invalid by a court of competent jurisdiction, the invalidity shall not affect other provisions or applications of the ordinance that can be given effect without the invalid provision or application, and to this end the provisions of this ordinance are severable.

SECTION 5. Work performed under any permit issued pursuant to Chapters 16.18A, 16.20A, and 16.26, Maui County Code, prior to the effective date of this ordinance and which is inspected on or after said effective date shall be approvable if it meets the requirements of either this chapter or Section 16.26.1300, Maui County Code, being repealed by this chapter.

SECTION 6. This ordinance shall apply to all applications for permits to be issued pursuant to Chapters 16.18A, 16.20A, and 16.26, Maui County Code, that are deemed complete by the Department of Public Works and Environmental Management on or after the effective date of this ordinance. Applications accepted before the effective date shall be approvable if it meets the requirements of either this chapter or section 16.26.1300, Maui County Code, being repealed by this chapter.

SECTION 7. Material to be repealed is bracketed. New material is underscored. In printing this bill, the County Clerk need not include the brackets, the bracketed material or the underscoring.

SECTION 8. This ordinance shall take effect ninety days after its approval.

APPROVED AS TO FORM AND LEGALITY:

Cindy Y. Young

CINDY Y. YOUNG
Deputy Corporation Counsel
County of Maui
S:\CLERICAL\KAO\ORD\Energy Code Draft 2.wpd

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2005 JAN 21 PM 3:36
OFFICE OF THE MAYOR

WE HEREBY CERTIFY that the foregoing BILL NO. 78 (2004)

1. Passed FINAL READING at the meeting of the Council of the County of Maui, State of Hawaii, held on 21st day of January, 2005, by the following vote:

G. Riki HOKAMA Chair	Robert CARROLL Vice-Chair	Michelle ANDERSON	Jo Anne JOHNSON	Dain P. KANE	Dennis A. MATEO	Michael J. MOLINA	Joseph PONTANILLA	Charmai TAVARE
Aye	Aye	Aye	Aye	Aye	Aye	Aye	Aye	Aye

2. Was transmitted to the Mayor of the County of Maui, State of Hawaii, on the 21st day of January, 2005.

DATED AT WAILUKU, MAUI, HAWAII, this 21st day of January, 2005.

G. RIKI HOKAMA, CHAIR
Council of the County of Maui

ROY T. HIRAGA, COUNTY CLERK
County of Maui

THE FOREGOING BILL IS HEREBY APPROVED THIS 25 DAY OF January, 2005.

ALAN M. ARAKAWA, MAYOR
County of Maui

I HEREBY CERTIFY that upon approval of the foregoing BILL by the Mayor of the County of Maui, the said B was designated as ORDINANCE NO. 3240 of the County of Maui, State of Hawaii.

ROY T. HIRAGA, COUNTY CLERK
County of Maui

Passed First Reading on November 5, 2004.
Effective date of Ordinance April 25, 2005.

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OFFICE OF THE
COUNTY CLERK

I HEREBY CERTIFY that the foregoing is a true and correct copy of Ordin No. 3240, the original of which is on file in the Office of the Co Clerk, County of Maui, State of Hawaii.

Dated at Wailuku, Hawaii, on

County Clerk, County of Maui